APPARATUS AND METHOD FOR DETECTION OF DETERIORATION OF LUBRICATING OIL

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Inventor: MORI AKIRA; UCHINO IKUO; HIROZAWA ATSUHIKO; YAMAZAKI KUNIHIRO
Applicant: KOMATSU MFG CO LTD
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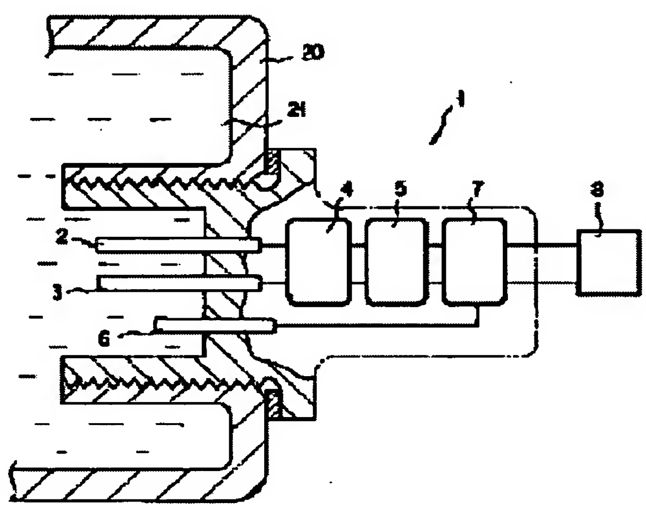
Abstract of **JP6201649**

PURPOSE:To measure the deterioration of a lubricating oil in a real-time manner in a size in which the apparatus can be mounted on a vehicle by a method wherein one pair of electrodes using an insert metal are immersed in the lubricating oil and a voltage generated across the electrodes is measured. CONSTITUTION:A lubricating-oil deterioration detector 1 is mounted on a vehicle engine 20, and one pair of electrodes 2, 3 using an inert metal are immersed in a lubricating oil 21. Then, an electric current generated across the electrodes 2, 3 is amplified, a voltage V0 is then measured by a voltage measuring instrument 5, and the voltage V0 is input to an operation part 7. The operation part 7 corrects a temperature by applying a signal form a temperature detection part 6 to the voltage V0. For this, a map for a temperature and a voltage is used. A total acid number is used as an index for the deterioration degree of the oil 21, a change in the measured voltage V0 with reference to a change in a known total acid number is formed as a map in advance, and the total acid number of the oil 21 is judged and displayed on a display part 8 while the measured voltage V0 is made to refer to the



map of the total acid number. Thereby, the small size and the real-time operation of the lubricating-oil deterioration detector 1 can be realized.

CLAIMS

[Claim(s)]

[Claim 1] Lubricating oil degradation detection equipment characterized by consisting of the electrodes 2 and 3 of a couple dipped in a lubricating oil 21, operation part 7 which calculates whenever [degradation] in the light of the total acid number map of the lubricating oil known beforehand from the electrical potential difference produced in these two electrodes 2 and 3, and a display 8 which displays that result.

[Claim 2] Lubricating oil degradation detection equipment given in a claim (1) characterized by using an inactive metal for one [at least] electrode among the electrodes 2 and 3 of a couple.

[Claim 3] Lubricating oil degradation detection equipment given in a claim (2) characterized by using gold, silver, or platinum as an inactive metal.

[Claim 4] The claim (2) characterized by using at least one of iridium, a ruthenium, a rhodium, or its oxides at the electrode of another side, or lubricating oil degradation detection equipment given in (3).

[Claim 5] The combination as a metal used for the electrodes 2 and 3 of a couple (1) rhodium-lead, (2) A platinum-indium, a (3) rhodium-indium, a (4) iridium-indium, (5) A lead-indium, (6) platinum-nickel, (7) rhodium-zinc, (8) Platinum-copper, (9) rhodium-copper, (10) iridium-copper, (11) lead-copper, (12) Lubricating oil degradation detection equipment given in a claim (1) characterized by using one combination of platinum-silver, (13) rhodium-silver, (14) iridium-silver, (15) lead-silver, and (16) iridium-zinc.

[Claim 6] The lubricating oil degradation detection approach characterized by getting to know the amount of lubricating oil additive, and the total acid number of an oil, and judging degradation of an oil by measuring the electrical potential difference produced by dipping into the oil which measures two electrodes.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the equipment which detects degradation of lubricating oils, such as an engine for cars and transmission, and its detection approach.

[0002]
[Description of the Prior Art] It is common to use the criterion in accordance with JIS or the specification of ASTM, for example, the total basicity, the total acid number, insoluble content, additive reduction, viscosity, etc. conventionally as an approach of judging degradation of the lubricating oil of bearing, such as lubricating oils, such as an engine for cars and transmission, or a steam turbine generator, and a hydroelectric generator. And what the detection equipment suitable for each criterion is proposed, and JP,61-96262,A etc. is one of things about the viscosity of them, and was shown in JP,59-121297,A about the total acid number is known for recent years.
[0003]
[Problem(s) to be Solved by the Invention] However, according to the criterion in accordance with above-mentioned conventional JIS or the specification of ASTM, the measuring device of dedication and special information are required for measurement. And since what was shown in JP,61-96262,A of viscosity measures the oil film of bearing and is asking for viscosity from the value, it is not common. Moreover, what was shown in JP,59-121297,A of the total acid number consists of precise weighing of a lubricating oil, dilution of a solvent, actuation of titration by the base, etc., and there is a problem of taking very complicated and great time amount. If a lubricating oil is furthermore sampled, the lubricating oil of the part must be filled up and the activity in respect of practical use is dramatically difficult. Although equipment is small and measurement on real time is required to especially equip a car etc., in the actual condition, anyone has the problem that it is cheaply immeasurable promptly easily, with the equipment which can be carried.
[0004] This invention is made in view of the above-mentioned thing, it is a thing, measurement on real time can perform degradation of a lubricating oil, and equipment aims at submitting small the lubricating oil degradation detection equipment which can be carried, and its detection approach also to a car.
[0005]
[Means for Solving the Problem] In order to attain the above-mentioned object, invention of the 1st of this invention consists of the electrode of a couple dipped in a lubricating oil, operation part which calculates whenever [degradation] from the electrical potential difference produced in these two electrodes in the light of the total acid number map of the lubricating oil known beforehand, and a display which displays that result. The 2nd invention uses an inactive metal for one [at least] electrode in the 1st above-mentioned invention. The 3rd invention uses gold, silver, or platinum as an inactive metal in the 2nd above-mentioned invention. the 4th invention

is looked like [the 2nd and 3rd invention], is set, and uses at least one of iridium, a ruthenium, a rhodium, or its oxides for the electrode of another side. the 5th invention -- the electrode of a couple -- public funds -- the combination as a group -- (1) rhodium-lead -- (2) A platinum-indium, a (3) rhodium-indium, a (4) iridium-indium, (5) A lead-indium, (6) platinum-nickel, (7) rhodium-zinc, (8) One combination of platinum-copper, (9) rhodium-copper, (10) iridium-copper, (11) lead-copper, (12) platinum-silver, (13) rhodium-silver, (14) iridium-silver, (15) lead-silver, and (16) iridium-zinc is used. By measuring the electrical potential difference produced by dipping into the lubricating oil which measures two electrodes, the 6th invention gets to know whenever [amount / of lubricating oil additive /, or lubricating oil's degradation], and judges degradation of a lubricating oil.

[0006]

[work --] for By dipping two electrodes into a lubricating oil, the electrical potential difference according to whenever [this lubricating oil's degradation] is taken out from two electrodes, and degradation of a lubricating oil is judged with this electrical potential difference.

[0007]

[The example of fruit **] The example of this invention is explained based on a drawing. The whole block diagram in which drawing 1 shows one example of the lubricating oil degradation detection equipment of this invention, and drawing 2 are circuit diagrams. In drawing 1, the engine 20 carried in the car which is not illustrated is equipped with lubricating oil degradation detection equipment 1, and it measures degradation of the lubricating oil 21 (henceforth an oil 21) which carries out the lubrication of the engine 20. Lubricating oil degradation detection equipment 1 consists of operation part 7 by which connection was carried out to the current amplifier 4 by which connection was carried out to the electrodes 2 and 3 of the couple which touches the oil to measure, and the electrodes 2 and 3 of a couple, the amplitude-measurement machine 5 by which connection was carried out to the current amplifier 4, and the temperature detection section 6 which touches the amplitude-measurement machine 5 and the oil to measure, and a display 8 which displays the result of operation part 7. Drawing 2 is a circuit diagram and uses the actuation amplifying circuit. It can change by one resistance R1, and differential gain is the magnification value V1 and V2. It can adjust. Moreover, it is the adjustable resistance R3 by the class of oil etc. (M) can adjust an output. The electrical potential difference V1 produced by dipping in the above into the oil 21 which measures the electrodes 2 and 3 of a couple, and V2 It leads to a current amplifier 4 and is an

electrical potential difference V0. It measures. This electrical potential difference V0 is led to operation part 7, and it is an electrical potential difference V0 at operation part 7. The signal from the temperature detection section 6 is impressed, and temperature compensation is performed. Since there is the temperature characteristic like drawing 4 in this, it is with the map of temperature and an electrical potential difference. Drawing 3 is a total acid number map in which change of the detection electrical potential difference in the lubricating oil degradation detection equipment 1 to change of an oil of the known total acid number beforehand is shown, judges the total acid number of the oil at that time in the light of this total acid number map, and displays the electrical potential difference detected and obtained on a display 8. In the above, oxidization iridium (1mm angle) was used for the electrode 2, silver (1mm round head) was used for the electrode 3 of another side, the electrode of this couple was dipped in the oil by die length of about 10mm, and the comparison with the measured electrical potential difference and the analysis value measured by the titration approach according to JIS and five kinds (A-E) were performed. Correlation as shown in drawing 3 is found, and the judgment of this result is possible by measuring the predetermined value of the total acid number. In addition, in the above-mentioned example, although oxidization iridium and silver were used for the electrode, iridium, a ruthenium, a rhodium, or its oxide may be used for one electrode, and inactive metals, such as gold and platinum, may be used for the electrode of another side.

[0008] Moreover, the combination of the following metals can also be used for the above-mentioned electrode pair. Namely, (1) rhodium-lead, a (2) platinum-indium, a (3) rhodium-indium, (4) An iridium-indium, a (5) lead-indium, (6) platinum-nickel, (7) Platinum-zinc, (8) rhodium-zinc, (9) platinum-copper, (10) rhodium-copper, (11) It is one combination of iridium-copper, (12) lead-copper, (13) platinum-silver, (14) rhodium-silver, (15) iridium-silver, (16) lead-silver, and (17) iridium-zinc.

[0009] The total acid number map in the combination of a metal pair from which a large number which contain an electrode pair in below differ is shown. In addition, each of this total acid number map has that desirable from which the total acid number obtains each detection electrical potential difference (mv), and plots this in a graph using seven kinds of known lubricating oils shown in a table 1, and this each point changes linearly to each lubricating oil as an electrode pair.

[0010]

[A table 1]

資料番号	全　酸　価
1	2．50
2	3．03
3	3．37
4	4．51
5	5．06
6	5．17
7	6．30

[0011] In addition, in a table 1, the 1st thing is new oil and the 7th thing deteriorates most.

[0012] It was the combination of platinum-copper which is shown in drawing 5 , and sequentially from the 1st, the detection electrical potential differences (mv) in each data of this are 186, 175, 147, 115, 98, 58, and 98, and changed linearly.

[0013] It was the combination of golden-copper which is shown in drawing 6 , and the detection electrical potential differences (mv) in each data of this are 90, 47, 69, 93, 84, 78, and 53 sequentially from the 1st, and did not change linearly.

[0014] It was the combination of rhodium-copper which is shown in drawing 7 , and sequentially from the 1st, the detection electrical potential differences (mv) in each data of this are 428, 277, 263, and 250,253,203,261, and changed to the abbreviation straight-line target.

[0015] It was the combination of iridium-copper which is shown in drawing 8 , and the detection electrical potential differences (mv) in each of this data are 330, 265, 260, 214, 197, -, 125 sequentially from the 1st, and good linearity was acquired.

[0016] It was the combination of 10 radium-copper which is shown in drawing 9 , and the detection electrical potential differences (mv) in each of this data are -894, -958, -950, -977, -993, -1086, -1024, and (1046) sequentially from the 1st, and linearity was acquired.

[0017] It was the combination of platinum-zinc which is shown in drawing 10 , and the detection electrical potential differences (mv) in each of this data are 730, 566, 535, 504, 506, 503, 533, and (456) sequentially from the 1st, and abbreviation linearity was acquired.

[0018] It was the combination of golden-zinc which is shown in drawing 11 , and the detection electrical potential differences (mv) in each of this data are 539, 454, 453, and 497,445,494,439 sequentially from the 1st, and linearity was not acquired.

[0019] It was the combination of rhodium-zinc which is shown in drawing 12 , and the detection electrical potential differences (mv) in each of this data are 757, 623, 634, 587, 566, 609, 576, and (537) sequentially from the 1st, and abbreviation linearity was acquired.

[0020] It was the combination of iridium-zinc which is shown in drawing 13 , and the detection electrical potential differences (mv) in each of this data are 498 (552), 516, 506, 480, 482, 446, 439, and (452) sequentially from the 1st, and linearity was acquired.

[0021] It was the combination of palladium-zinc which is shown in drawing 14 , and the detection electrical potential differences (mv) in each of this data are -648, (-624), -618, -625, -635, -653, -683, -670, and (-663) sequentially from the 1st, and linearity was not acquired.

[0022] It was the combination of platinum-nickel which is shown in drawing 15 , and the detection electrical potential differences (mv) in each of this data are 346, 260, 260, 230, 241, 227, 230, and (243) sequentially from the 1st, and linearity was acquired.

[0023] It was the combination of golden-nickel which is shown in drawing 16 , and the detection electrical potential differences (mv) in each of this data are 152, 114, 131, and 154,170,190,130 sequentially from the 1st, and linearity was not acquired.

[0024] It was the combination of rhodium-nickel which is shown in drawing 17 , and the detection electrical potential differences (mv) in each of this data are 335, 305, 307, and 304,303,304,276 sequentially from the 1st, and change was not seen by the detection electrical potential difference in spite of change of the total acid number.

[0025] It was the combination of iridium-nickel which is shown in drawing 18 , and sequentially from the 1st, the detection electrical potential differences (mv) in each of this data are 278, 264, 260, and 262,278,254,264, and there was no change in a detection electrical potential difference.

[0026] It was the combination of palladium-nickel which is shown in drawing 19 , and the detection electrical potential differences (mv) in each of this data are -848, -936, -913, -885, -882, -888, and -913 sequentially from the 1st, and linearity was not acquired.

[0027] It was the combination of a platinum-indium which is shown in drawing 20 , and the detection electrical potential differences (mv) in each of this data are 643, 572, 568, and 509,479,418,422 sequentially from the 1st, and linearity was acquired.

[0028] It was the combination of a golden-indium which is shown in drawing 21 , and sequentially from the 1st, the detection electrical potential differences (mv) in each of this data are 476, 447, 451, and 422,417,422,415, and there was no change in a detection electrical potential difference.

[0029] It was the combination of a rhodium-indium which is shown in drawing 22 , and the detection electrical potential differences (mv) in each of this data are 679, 628, 620, and 575,569,501,512 sequentially from the 1st, and linearity was acquired.
[0030] It was the combination of an iridium-indium which is shown in drawing 23 , and the detection electrical potential differences (mv) in each of this data are 538, (612), and 547, 527 and 484,460,424,413 sequentially from the 1st, and linearity was acquired.
[0031] It was the combination of a lead-indium which is shown in drawing 24 , and the detection electrical potential differences (mv) in each of this data are −447, −524, −562, −598, −641, −690, and −612 sequentially from the 1st, and abbreviation linearity was acquired.
[0032] It was the combination of platinum-lead which is shown in drawing 25 , and the detection electrical potential differences (mv) in each of this data are 537, 415, 446, and 426,411,417,430 (443) sequentially from the 1st, and linearity was not acquired.
[0033] It was the combination of golden-lead which is shown in drawing 26 , and sequentially from the 1st, the detection electrical potential differences (mv) in each of this data are 376, 315, 347, and 351,348,395,377, and there was no change in a detection electrical potential difference.
[0034] It was the combination of rhodium-lead which is shown in drawing 27 , and the detection electrical potential differences (mv) in each of this data are 616, 520, 532, and 495,482,484,503 sequentially from the 1st, and abbreviation linearity was acquired.
[0035] It was the combination of iridium-lead which is shown in drawing 28 , and sequentially from the 1st, the detection electrical potential differences (mv) in each of this data were 477, 438, 440, and 443,432,414,432, and there was little change of a detection electrical potential difference.
[0036] It was the combination of palladium-lead which is shown in drawing 29 , and sequentially from the 1st, the detection electrical potential differences (mv) in each of this data were −625, −665, −663, −690, −665, −712, and −682, and the detection electrical potential difference had little change.
[0037] It was the combination of platinum-silver which is shown in drawing 30 , and the detection electrical potential differences (mv) in each of this data are 520, 404, 407, 360, 308, 250, 322, and (274) sequentially from the 1st, and linearity was acquired.
[0038] It was the combination of golden-silver which is shown in drawing 31 , and the detection electrical potential differences (mv) in each of this data are (330, −, 263, 230, 221, 228 and 230, 197) sequentially from the 1st, and linearity was not acquired.
[0039] It was the combination of rhodium-silver which is shown in drawing 32 , and the detection electrical potential differences (mv) in each of this data are 546, 462, 445,

406, 370, 300, 378, and (315) sequentially from the 1st, and linearity was acquired.
[0040] It was the combination of iridium-silver which is shown in drawing 33 , and the detection electrical potential differences (mv) in each of this data are 460, 425, 448, and 372,367,327,302 sequentially from the 1st, and good linearity was acquired.
[0041] It was the combination of palladium-silver which is shown in drawing 34 , and the detection electrical potential differences (mv) in each of this data are −647, −703, −720, −749, −776, −726, and −796 sequentially from the 1st, and linearity was acquired.
[0042] It was the combination of iridium-iron which is shown in drawing 35 , and sequentially from the 1st, the detection electrical potential differences (mv) in each of this data are 494, 431, 422, and 418,412,420,490, and there was no regularity in change of a detection electrical potential difference.
[0043] It was the combination of iridium-aluminum which is shown in drawing 36 , and sequentially from the 1st, the detection electrical potential differences (mv) in each of this data are 985, 1025, 1025, 1006, 1005, 1020, and 1014, and there was no change in a detection electrical potential difference.
[0044] It was the combination of iridium-magnesium which is shown in drawing 37 , and sequentially from the 1st, the detection electrical potential differences (mv) in each of this data are 1113, 1033, 1048, 1109, 1075, 1037, and 1030, and there was no regularity in a detection electrical potential difference.
[0045] If the combination of an electrode pair which changes with change of all oxidation from each above-mentioned experiment by the ratio with a fixed change of a detection electrical potential difference is chosen The combination (1) rhodium-lead, a (2) platinum-indium, (3) rhodium-iridium, (4) An iridium-indium, a (5) lead-indium, (6) platinum-nickel, (7) Rhodium-zinc, (8) platinum-copper, (9) rhodium-copper, (10) iridium-copper, (11) It turned out that the electrode pair of the combination of lead-copper, (12) platinum-silver, (13) rhodium-silver, (14) iridium-silver, (15) lead-silver, and (16) iridium-zinc can use.
[0046]
[Effect of the Invention] As explained above, according to this invention, degradation of an oil can be judged by measuring the electrical potential difference produced by dipping into the oil which measures two electrodes. Since the inactive metal is used to (b) acidity corrosion as a description in this case, the corrosion of an electrode is avoided and it can be used in the long run.
(b) Since the hydrogen electrode regularly used as a reference electrode, the calomel electrode, the silver-silver chloride electrode, etc. are not used, the supplement of internal liquid, gas, etc. becomes unnecessary and it becomes usable over a long

period of time.
(c) Moreover, the internal liquid of these reference electrodes is water, and although it cannot be used, since it is using only the metal electrode, it can be used at an elevated temperature, and it can be attached to an engine etc. direct picking in a location [elevated temperature / engine].
(d) Since it is considering as the metal electrode without using a reference electrode also in this case, although the pressure of a fluid is applied to an electrode when it attaches to the passage of lubricating oils, such as an engine, direct picking, it can attach direct picking.
** -- since effectiveness [like] arises, and miniaturization real-time measurement of equipment is attained and the result is displayed on a display, the outstanding effectiveness that anyone can do measurement cheaply promptly easily is acquired.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the whole block diagram showing one example of the lubricating oil degradation detection equipment of this invention.
[Drawing 2] It is a circuit diagram.
[Drawing 3] It is the diagram showing the analysis value measured by the titration approach according to the electrical potential difference and JIS which were measured with this invention equipment.
[Drawing 4] It is the diagram showing the relation between temperature and an electrical potential difference.
[Drawing 5] When the construction material combination of an electrode pair is platinum-copper, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 6] When the construction material combination of an electrode pair is golden-copper, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 7] When the construction material combination of an electrode pair is rhodium-copper, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 8] When the construction material combination of an electrode pair is iridium-copper, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 9] When the construction material combination of an electrode pair is palladium-copper, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 10] When the construction material combination of an electrode pair is platinum-zinc, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 11] When the construction material combination of an electrode pair is golden-zinc, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 12] When the construction material combination of an electrode pair is rhodium-zinc, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 13] When the construction material combination of an electrode pair is iridium-zinc, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 14] When the construction material combination of an electrode pair is palladium-zinc, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 15] When the construction material combination of an electrode pair is platinum-nickel, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 16] When the construction material combination of an electrode pair is golden-nickel, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 17] When the construction material combination of an electrode pair is rhodium-nickel, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 18] When the construction material combination of an electrode pair is iridium-nickel, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 19] When the construction material combination of an electrode pair is palladium-nickel, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 20] When the construction material combination of an electrode pair is a platinum-indium, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 21] When the construction material combination of an electrode pair is a golden-indium, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 22] When the construction material combination of an electrode pair is a rhodium-indium, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 23] When the construction material combination of an electrode pair is an iridium-indium, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 24] When the construction material combination of an electrode pair is a palladium-indium, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 25] When the construction material combination of an electrode pair is platinum-lead, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 26] When the construction material combination of an electrode pair is golden-lead, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 27] When the construction material combination of an electrode pair is rhodium-lead, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 28] When the construction material combination of an electrode pair is indium-lead, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 29] When the construction material combination of an electrode pair is palladium-lead, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 30] When the construction material combination of an electrode pair is platinum-silver, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 31] When the construction material combination of an electrode pair is golden-silver, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 32] When the construction material combination of an electrode pair is rhodium-silver, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Drawing 33] When the construction material combination of an electrode pair is iridium-silver, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 34] When the construction material combination of an electrode pair is palladium-silver, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 35] When the construction material combination of an electrode pair is iridium-iron, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 36] When the construction material combination of an electrode pair is indium-aluminum, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.
[Drawing 37] When the construction material combination of an electrode pair is iridium-magnesium, it is the diagram showing change of the detection electrical potential difference in data which are different in the total acid number.

[Description of Notations]

1 Lubricating oil degradation detection equipment, and 2 and 3 are an electrode and 4. A current amplifier, 5 A voltage amplifier, 6 The temperature detection section, 7 Operation part, 8 An indicating equipment, 20 An engine, 21 Lubricating oil.

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(71)出願人　000001236
株式会社小松製作所
東京都港区赤坂二丁目３番６号
(72)発明者　森　彰
神奈川県平塚市万田1200　株式会社小松製作所研究所内
(72)発明者　内野　郁夫
神奈川県平塚市万田1200　株式会社小松製作所研究所内
(72)発明者　広沢　敏彦
神奈川県平塚市万田1200　株式会社小松製作所研究所内
(74)代理人　弁理士　米原　正章　（外２名）

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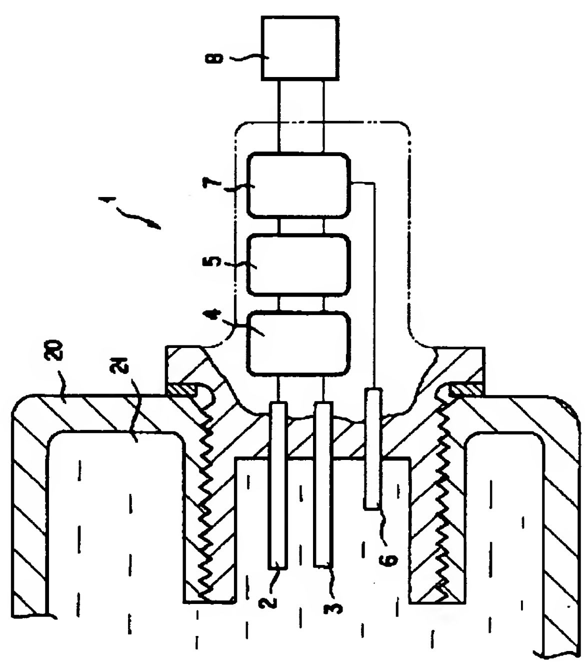
(54)【発明の名称】　潤滑油劣化検出装置及びその検出方法

(57)【要約】
【目的】　測定する潤滑油の中に浸すことにより潤滑油の劣化を判定することができるようにした潤滑油劣化検出装置及びその検出方法を提供することにある。
【構成】　一対の電極２，３を潤滑油２１に浸し、上記電極２，３の検出電圧により潤滑油２１の全酸価を知り、これから潤滑油の劣化度を判定する。



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【特許請求の範囲】

【請求項1】　潤滑油21に浸す一対の電極2，3と、この両電極2，3に生じた電圧から、あらかじめ知られている潤滑油の全酸価マップに照して劣化度を演算する演算部7と、その結果を表示する表示部8とからなることを特徴とする潤滑油劣化検出装置。

【請求項2】　一対の電極2，3のうち、少なくとも一方の電極に不活性金属を用いたことを特徴とする請求項（1）記載の潤滑油劣化検出装置。

【請求項3】　不活性金属として金、銀、白金のいずれかを用いることを特徴とする請求項（2）記載の潤滑油劣化検出装置。

【請求項4】　他方の電極にイリジウム、ルテニウム、ロジウム、もしくはその酸化物のうちの少なくとも1つを用いたことを特徴とする請求項（2）あるいは（3）記載の潤滑油劣化検出装置。

【請求項5】　一対の電極2，3に用いる金属としての組合せを、（1）ロジウム－鉛、（2）白金－インジウム、（3）ロジウム－インジウム、（4）イリジウム－インジウム、（5）鉛－インジウム、（6）白金－ニッケル、（7）ロジウム－亜鉛、（8）白金－銅、（9）ロジウム－銅、（10）イリジウム－銅、（11）鉛－銅、（12）白金－銀、（13）ロジウム－銀、（14）イリジウム－銀、（15）鉛－銀、（16）イリジウム－亜鉛のいずれかの組合せを用いたことを特徴とする請求項（1）記載の潤滑油劣化検出装置。

【請求項6】　2つの電極を測定する油の中に浸すことによって生ずる電圧を測定することにより、潤滑油添加剤の量や油の全酸価を知り、油の劣化を判定することを特徴とする潤滑油劣化検出方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、車両用のエンジン、トランスミッション等の潤滑油の劣化を検出する装置及びその検出方法に関するものである。

【0002】

【従来の技術】従来、車両用のエンジン、トランスミッション等の潤滑油、あるいはタービン発電機、水力発電機等の軸受の潤滑油の劣化を判定する方法としては、ＪＩＳやＡＳＴＭの規格に則った判定基準、例えば全塩基価、全酸価、不溶解分、添加物減少、粘度等を用いることが一般的である。そして近年では、それぞれの判定基準に適した検出装置が提案されており、そのうちの粘度に関するものとしては特開昭61－96262号公報等があり、また全酸価に関しては特開昭59－121297号公報に示されたものが知られている。

【0003】

【発明が解決しようとする課題】しかしながら、上記従来のＪＩＳやＡＳＴＭの規格に則った判定基準によれば、測定に専用の測定装置と専門の知識が必要である。

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そして粘度の特開昭61－96262号公報に示されたものは、軸受の油膜を測定し、その値より粘度を求めているため一般的でない。また全酸価の特開昭59－121297号公報に示されたものは、潤滑油の精秤、溶剤の希釈、塩基での滴定の操作等から成り立っており、非常に煩雑かつ、多大な時間がかかるという問題がある。さらに潤滑油をサンプリングしてしまうと、その分の潤滑油を補充しなければならず、実用面での使用は非常に困難である。特に車両等に装備する場合には装置が小さくて、リアルタイムでの測定が必要であるが、現状では搭載可能な装置で誰でも容易に、迅速に、安価に計測することができないという問題がある。

【0004】本発明は上記のことにかんがみなされもので、潤滑油の劣化をリアルタイムでの測定ができ、装置が小さく車両にも搭載が可能な潤滑油劣化検出装置及びその検出方法を提出することを目的とするものである。

【0005】

【課題を解決するための手段】上記目的を達成するために、本発明の第1の発明は、潤滑油に浸す一対の電極と、この両電極に生じた電圧から、あらかじめ知られている潤滑油の全酸価マップに照して劣化度を演算する演算部と、その結果を表示する表示部とからなっている。第2の発明は、上記第1の発明において、少なくとも一方の電極に不活性金属を用いる。第3の発明は、上記第2の発明において、不活性金属として金、銀、白金のいずれかを用いる。第4の発明は、第2、第3の発明において、他方の電極に、イリジウム、ルテニウム、ロジウムもしくはその酸化物のうち少なくとも1つを用いている。第5の発明は、一対の電極用金属としての組合せを（1）ロジウム－鉛、（2）白金－インジウム、（3）ロジウム－インジウム、（4）イリジウム－インジウム、（5）鉛－インジウム、（6）白金－ニッケル、（7）ロジウム－亜鉛、（8）白金－銅、（9）ロジウム－銅、（10）イリジウム－銅、（11）鉛－銅、（12）白金－銀、（13）ロジウム－銀、（14）イリジウム－銀、（15）鉛－銀、（16）イリジウム－亜鉛のいずれかの組合せを用いる。第6の発明は、2つの電極を測定する潤滑油の中に浸すことによって生じる電圧を測定することにより、潤滑油添加剤の量や潤滑油の劣化度を知り、潤滑油の劣化を判定する。

【0006】

【作　　用】2つの電極を潤滑油中に浸すことにより、この潤滑油の劣化度に応じた電圧が両電極から取り出され、この電圧により、潤滑油の劣化が判定される。

【0007】

【実　施　例】本発明の実施例を図面に基づいて説明する。図1は本発明の潤滑油劣化検出装置の一実施例を示す全体構成図、図2は回路図である。第1図において、潤滑油劣化検出装置1は図示しない車両に搭載されたエンジン20に装着され、エンジン20を潤滑する潤滑油

２１（以下、油２１という。）の劣化を測定する。潤滑油劣化検出装置１は測定する油に接する一対の電極２，３と、一対の電極２，３に結線された電流増幅器４と、電流増幅器４に結線された電圧測定器５と、電圧測定器５および測定する油に接する温度検知部６とに結線された演算部７と、演算部７の結果を表示する表示装置８とから構成されている。図２は回路図であり、作動増幅回路を用いている。差動利得は１個の抵抗R_1により変えることができ、増幅値V_1，V_2を調整できる。また、油の種類等により可変の抵抗R_3（M）により出力を調整することができる。上記において、一対の電極２，３を測定する油２１の中に浸すことによって生ずる電圧V_1，V_2を電流増幅器４に導き、電圧V_0を測定する。この電圧V_0を演算部７に導き、演算部７では、電圧V_0に温度検知部６からの信号を印加して温度補正を行う。これには例えば、図４のような温度特性があるため温度と電圧のマップをもちいる。図３は油の予め既知の全酸価の変化に対する潤滑油劣化検出装置１での検出電圧の変化を示す全酸価マップであり、検出して得られた電圧をこの全酸価マップに照らしてそのときの油の全酸価を判定し、表示部８に表示する。上記において、例えば、電極２に酸化イリジウム（１mm角）を、他方の電極３に銀（１mm丸）を用い、この一対の電極を約１０mmの長さで油に浸して、測定した電圧とＪＩＳに従って滴定方法により測定した分析値との比較、５種類（Ａ～Ｅ）を行った。この結果は図３に示すごとくの相関がみられ、全酸価の所定値を計測することにより判定ができる。なお、上記実施例では、電極に酸化イリジウムと銀を用いたが、一方の電極に、イリジウム、ルテニウム、ロジウムあるいはその酸化物を、他方の電極に、金、白金等の不活性金属を用いてもよい。

【０００８】また上記電極対には次のような金属の組合せを用いることもできる。すなわち、（１）ロジウム－鉛、（２）白金－インジウム、（３）ロジウム－インジウム、（４）イリジウム－インジウム、（５）鉛－インジウム、（６）白金－ニッケル、（７）白金－亜鉛、（８）ロジウム－亜鉛、（９）白金－銅、（１０）ロジウム－銅、（１１）イリジウム－銅、（１２）鉛－銅、（１３）白金－銀、（１４）ロジウム－銀、（１５）イリジウム－銀、（１６）鉛－銀、（１７）イリジウム－亜鉛のいずれかの組合せである。

【０００９】以下に電極対を含む多数の異なる金属対の組合せにおける全酸価マップを示す。なおこの各全酸価マップは全酸価が表１に示す既知の７種類の潤滑油を用い、それぞれの検出電圧（mv）を得、これをグラフにプロットしたものであり、この各点が各潤滑油で直線的に変化するものが電極対として好ましいものである。

【００１０】

【表１】

資料番号	全　酸　価
1	2．50
2	3．03
3	3．37
4	4．51
5	5．06
6	5．17
7	6．30

【００１１】なお表１において、１番目のものは新しいオイルであり、７番目のものは最も劣化したものである。

【００１２】図５に示すものは、白金－銅の組合せで、これの各資料における検出電圧（ｍｖ）は１番目から順に、１８６，１７５，１４７，１１５，９８，５８，９８であり、直線的に変化した。

【００１３】図６に示すものは、金－銅の組合せで、これの各資料における検出電圧（ｍｖ）は１番目から順に９０，４７，６９，９３，８４，７８，５３であり、直線的に変化しなかった。

【００１４】図７に示すものは、ロジウム－銅の組合わせであり、これの各資料における検出電圧（ｍｖ）は１番目から順に、４２８，２７７，２６３，２５０，２５３，２０３，２６１であり、略直線的に変化した。

【００１５】図８に示すものは、イリジウム－銅の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、３３０，２６５，２６０，２１４，１９７，－，１２５であり、良好な直線性が得られた。

【００１６】図９に示すものは、１０ラジウム－銅の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、－８９４，－９５８，－９５０，－９７７，－９９３，－１０８６，－１０２４，（１０４６）であり、直線性が得られた。

【００１７】図１０に示すものは、白金－亜鉛の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、７３０，５６６，５３５，５０４，５０６，５０３，５３３，（４５６）であり、略直線性が得られた。

【００１８】図１１に示すものは金－亜鉛の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、５３９，４５４，４５３，４９７，４４５，４９４，４３９であり、直線性が得られなかった。

【００１９】図１２に示すものはロジウム－亜鉛の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、７５７，６２３，６３４，５８７，５６６，６０９，５７６，（５３７）であり、略直線性が得られた。

【００２０】図１３に示すものは、イリジウム－亜鉛の組合せで、この各資料における検出電圧（ｍｖ）は１番

目から順に、４９８（５５２），５１６，５０６，４８０，４８２，４４６，４３９，（４５２）であり、直線性が得られた。

【００２１】図１４に示すものはパラジウム－亜鉛の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、－６４８，（－６２４），－６１８，－６２５，－６３５，－６５３，－６８３，－６７０，（－６６３）であり、直線性が得られなかった。

【００２２】図１５に示すものは白金－ニッケルの組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、３４６，２６０，２６０，２３０，２４１，２２７，２３０，（２４３）であり、直線性が得られた。

【００２３】図１６に示すものは、金－ニッケルの組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、１５２，１１４，１３１，１５４，１７０，１９０，１３０であり、直線性が得られなかった。

【００２４】図１７に示すものはロジウム－ニッケルの組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、３３５，３０５，３０７，３０４，３０３，３０４，２７６であり、全酸価の変化にもかかわらず、検出電圧に変化がみられなかった。

【００２５】図１８に示すものはイリジウム－ニッケルの組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、２７８，２６４，２６０，２６２，２７８，２５４，２６４であり、検出電圧に変化がなかった。

【００２６】図１９に示すものは、パラジウム－ニッケルの組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、－８４８，－９３６，－９１３，－８８５，－８８２，－８８８，－９１３であり、直線性が得られなかった。

【００２７】図２０に示すものは白金－インジウムの組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、６４３，５７２，５６８，５０９，４７９，４１８，４２２であり、直線性が得られた。

【００２８】図２１に示すものは金－インジウムの組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、４７６，４４７，４５１，４２２，４１７，４２２，４１５であり、検出電圧に変化がなかった。

【００２９】図２２に示すものは、ロジウム－インジウムの組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、６７９，６２８，６２０，５７５，５６９，５０１，５１２であり、直線性が得られた。

【００３０】図２３に示すものはイリジウム－インジウムの組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、５３８，（６１２），５４７，５２７，４８４，４６０，４２４，４１３であり、直線性が得られた。

【００３１】図２４に示すものは鉛－インジウムの組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、－４４７，－５２４，－５６２，－５９８，－６４１，－６９０，－６１２であり、略直線性が得られた。

【００３２】図２５に示すものは、白金－鉛の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、５３７，４１５，４４６，４２６，４１１，４１７，４３０（４４３）であり、直線性が得られなかった。

【００３３】図２６に示すものは金－鉛の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、３７６，３１５，３４７，３５１，３４８，３９５，３７７であり、検出電圧に変化がなかった。

【００３４】図２７に示すものはロジウム－鉛の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、６１６，５２０，５３２，４９５，４８２，４８４，５０３であり、略直線性が得られた。

【００３５】図２８に示すものは、イリジウム－鉛の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、４７７，４３８，４４０，４４３，４３２，４１４，４３２であり、検出電圧の変化が少なかった。

【００３６】図２９に示すものはパラジウム－鉛の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、－６２５，－６６５，－６６３，－６９０，－６６５，－７１２，－６８２であり、検出電圧に変化が少なかった。

【００３７】図３０に示すものは白金－銀の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、５２０，４０４，４０７，３６０，３０８，２５０，３２２，（２７４）であり、直線性が得られた。

【００３８】図３１に示すものは金－銀の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、３３０，－，２６３，２３０，２２１，２２８，２３０，（１９７）であり、直線性が得られなかった。

【００３９】図３２に示すものは、ロジウム－銀の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、５４６，４６２，４４５，４０６，３７０，３００，３７８，（３１５）であり、直線性が得られた。

【００４０】図３３に示すものはイリジウム－銀の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、４６０，４２５，４４８，３７２，３６７，３２７，３０２であり、良好な直線性が得られた。

【００４１】図３４に示すものはパラジウム－銀の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、－６４７，－７０３，－７２０，－７４９，－７７６，－７２６，－７９６であり、直線性が得られた。

【００４２】図３５に示すものは、イリジウム－鉄の組合せで、この各資料における検出電圧（ｍｖ）は１番目から順に、４９４，４３１，４２２，４１８，４１２，４２０，４９０であり、検出電圧の変化に規則性がなか

った。

【0043】図36に示すものはイリジウム－アルミニウムの組合せで、この各資料における検出電圧（mv）は1番目から順に、985，1025，1025，1006，1005，1020，1014であり、検出電圧に変化がなかった。

【0044】図37に示すものはイリジウム－マグネシウムの組合せで、この各資料における検出電圧（mv）は1番目から順に、1113，1033，1048，1109，1075，1037，1030であり、検出電圧に規則性がなかった。

【0045】上記各実験から全酸化の変化により検出電圧の変化が一定の比率で変化する電極対の組合わせを選ぶと、その組合せは（1）ロジウム－鉛、（2）白金－インジウム、（3）ロジウム－イリジウム、（4）イリジウム－インジウム、（5）鉛－インジウム、（6）白金－ニッケル、（7）ロジウム－亜鉛、（8）白金－銅、（9）ロジウム－銅、（10）イリジウム－銅、（11）鉛－銅、（12）白金－銀、（13）ロジウム－銀、（14）イリジウム－銀、（15）鉛－銀、（16）イリジウム－亜鉛の組合せの電極対が用いることができることがわかった。

【0046】

【発明の効果】以上説明したように、本発明によれば、2つの電極を測定する油の中に浸すことによって生ずる電圧を測定することにより、油の劣化を判定することができる。この際の特徴として

（イ）酸性腐蝕に対して不活性な金属を使用しているため電極の腐蝕が避けられ長期的に使用できる。

（ロ）比較電極として常用される水素電極、甘コウ電極、銀塩化銀電極等を用いていないため内部液、ガス等の補充が不用となり長期にわたる使用が可能となる。

（ハ）またこれら比較電極の内部液は水でありエンジン等の高温な場所では使用できないのであるが金属電極のみを使用しているため高温で使用でき、エンジン等に直接取り付けることができる。

（ニ）エンジン等潤滑油の流路に直接取り付けた場合には流体の圧力が電極にかかるがこの場合においても比較電極を用いないで金属電極としているために直接取り付けることができる。

のような効果が生じ装置の小型化リアルタイム測定が可能になり、かつその結果が表示装置に表示されるため、誰でも容易に、迅速に、安価に、計測が出来るという優れた効果が得られる。

【図面の簡単な説明】

【図1】本発明の潤滑油劣化検出装置の一実施例を示す全体構成図である。

【図2】回路図である。

【図3】本発明装置にて測定した電圧とＪＩＳに従って滴定方法により測定した分析値を示す線図である。

【図4】温度と電圧の関係を示す線図である。

【図5】電極対の材質組合せが白金－銅の場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図6】電極対の材質組合せが金－銅の場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図7】電極対の材質組合せがロジウム－銅の場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図8】電極対の材質組合せがイリジウム－銅の場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図9】電極対の材質組合せがパラジウム－銅の場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図10】電極対の材質組合せが白金－亜鉛の場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図11】電極対の材質組合せが金－亜鉛の場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図12】電極対の材質組合せがロジウム－亜鉛の場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図13】電極対の材質組合せがイリジウム－亜鉛の場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図14】電極対の材質組合せがパラジウム－亜鉛の場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図15】電極対の材質組合せが白金－ニッケルの場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図16】電極対の材質組合せが金－ニッケルの場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図17】電極対の材質組合せがロジウム－ニッケルの場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図18】電極対の材質組合せがイリジウム－ニッケルの場合全酸価が異なる資料における検出電圧の変化を示す線図である。

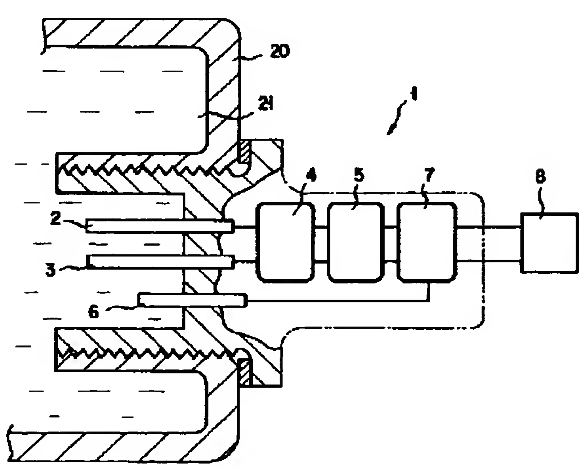
【図19】電極対の材質組合せがパラジウム－ニッケルの場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図20】電極対の材質組合せが白金－インジウムの場合全酸価が異なる資料における検出電圧の変化を示す線図である。

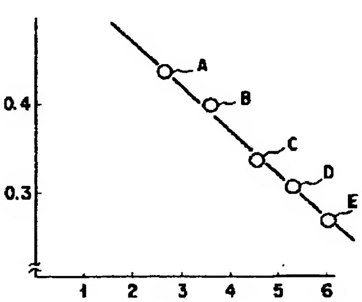
【図21】電極対の材質組合せが金－インジウムの場合全酸価が異なる資料における検出電圧の変化を示す線図である。

【図２２】電極対の材質組合せがロジウム－インジウムの場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図２３】電極対の材質組合せがイリジウム－インジウムの場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図２４】電極対の材質組合せがパラジウム－インジウムの場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図２５】電極対の材質組合せが白金－鉛の場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図２６】電極対の材質組合せが金－鉛の場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図２７】電極対の材質組合せがロジウム－鉛の場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図２８】電極対の材質組合せがインジウム－鉛の場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図２９】電極対の材質組合せがパラジウム－鉛の場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図３０】電極対の材質組合せが白金－銀の場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図３１】電極対の材質組合せが金－銀の場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図３２】電極対の材質組合せがロジウム－銀の場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図３３】電極対の材質組合せがイリジウム－銀の場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図３４】電極対の材質組合せがパラジウム－銀の場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図３５】電極対の材質組合せがイリジウム－鉄の場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図３６】電極対の材質組合せがインジウム－アルミニウムの場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【図３７】電極対の材質組合せがイリジウム－マグネシウムの場合全酸価が異なる資料における検出電圧の変化を示す線図である。
【符号の説明】
１　潤滑油劣化検出装置、２，３は電極、４　電流増幅器、５　電圧増幅器、６　温度検知部、７　演算部、８　表示装置、２０　エンジン、２１　潤滑油。

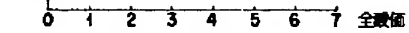
【図１】



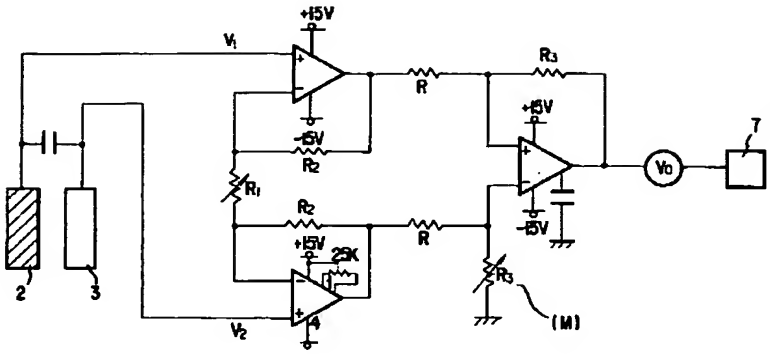
【図３】



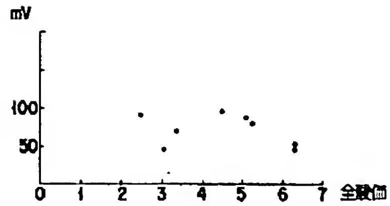
【図５】



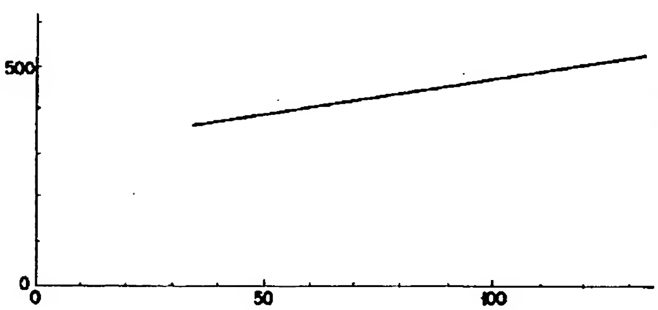
【図2】



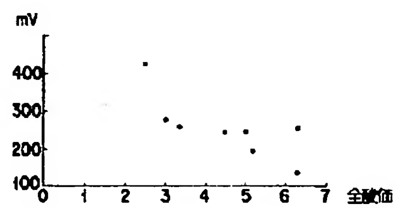
【図6】



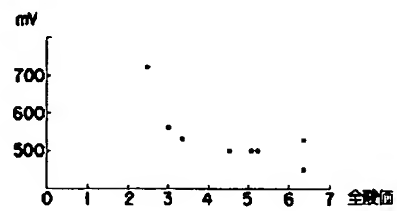
【図4】



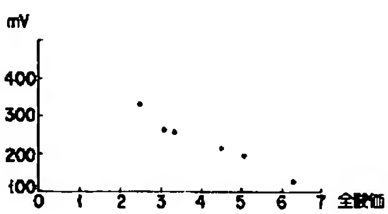
【図7】



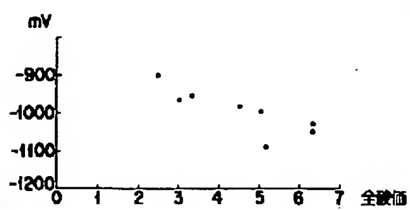
【図10】



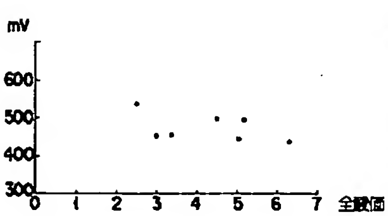
【図8】



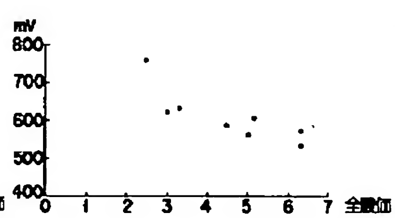
【図9】



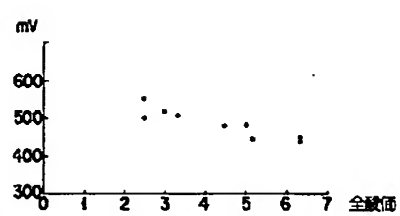
【図11】



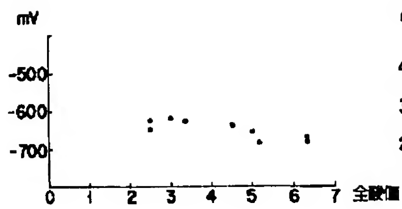
【図12】



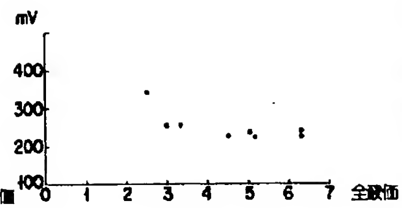
【図13】



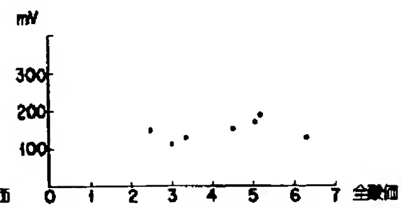
【図14】



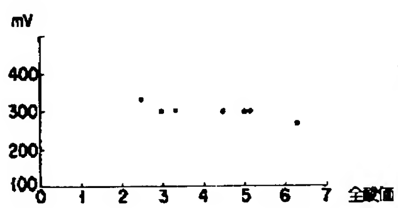
【図15】



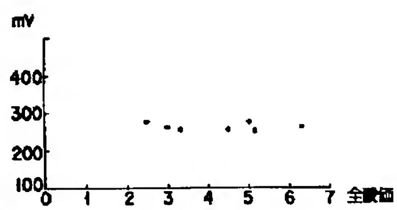
【図16】



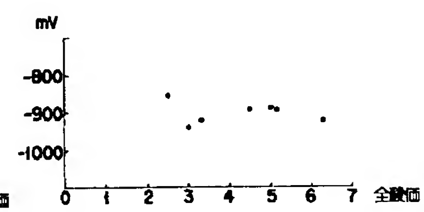
【図17】



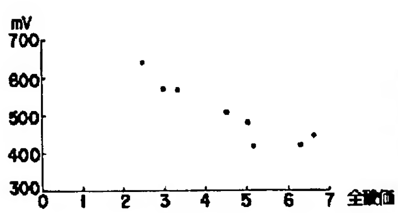
【図18】



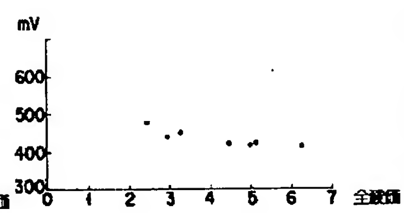
【図19】



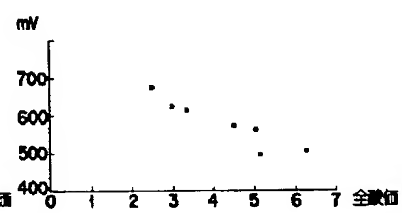
【図20】



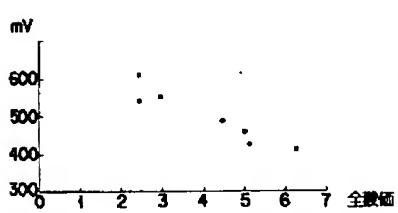
【図21】



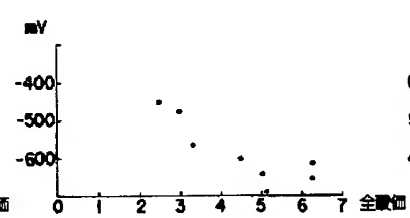
【図22】



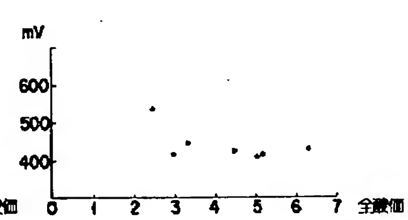
【図23】



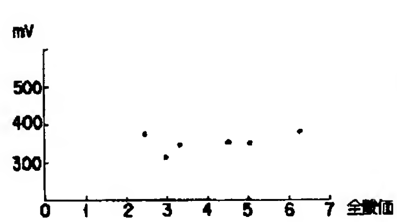
【図24】



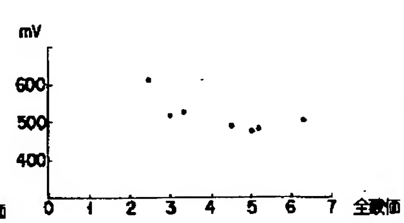
【図25】



【図26】



【図27】



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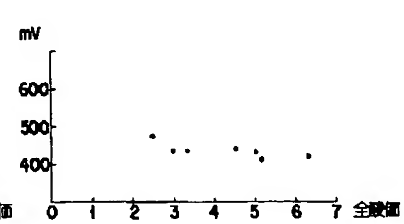

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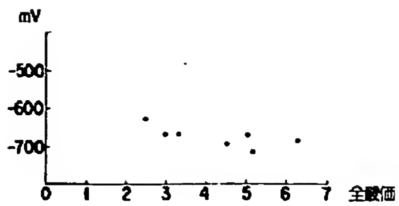

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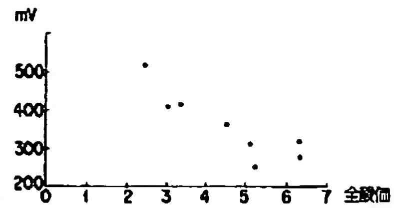

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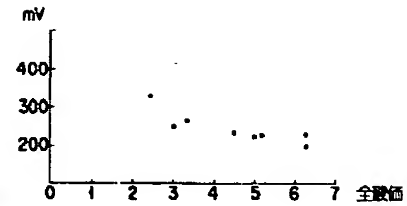

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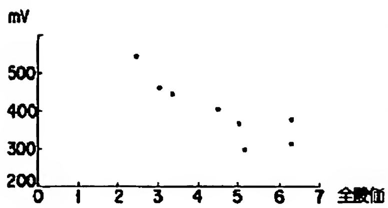

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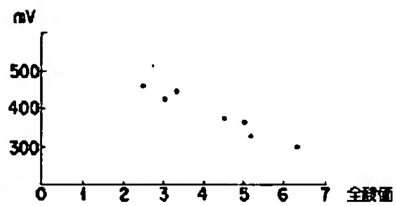

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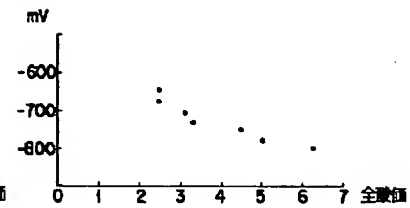

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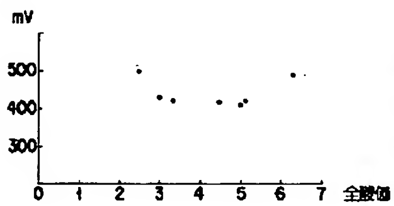

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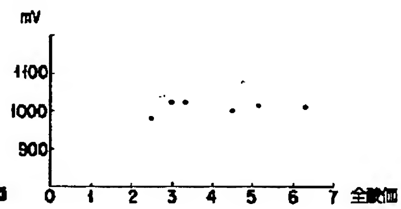

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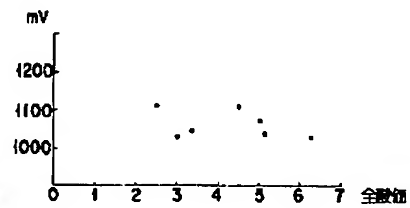

フロントページの続き

(72)発明者　山崎　国博
神奈川県平塚市万田1200　株式会社小松製
作所研究所内